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Before the
Federal Communications Commission
Washington, DC 20554

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In the Matter of	)	
	)	
Amendment of Parts 2 and 15 to	)	
Prohibit Marketing of Radio Scanners	)	ET Docket No. 93-1
Capable of Intercepting Cellular	)	
Telephone Conversations	)	

RECEIVED
FEB 22 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

COMMENTS OF JEFFREY KRAUSS

Jeffrey Krauss submits these comments in response to the Notice of Proposed Rulemaking ("Notice") herein[1] with respect to restrictions on the design of scanner radio receivers.

SUMMARY OF POSITION

Widely available inexpensive scanners serve the public interest by supporting improved intra-jurisdictional and inter-jurisdictional communications between and among public safety agencies, by providing information to the news media for public dissemination, and by minimizing traffic congestion. In addition, there is a widespread demand for scanners by the general public.

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List A B C D E

[1]FCC 93-1, released January 13, 1993.

The benefits of the proposed rules are likely to be small, so long as the cellular industry continues to use analog technology. Thousands of scanners will have been manufactured prior to the 1994 effective date of these rules. Moreover, it is likely that cellular transceivers can be illegally modified to act as scanner receivers, if there are sufficient economic benefits.

The Commission should not require the total redesign of existing scanners, nor the development of specialized models that are intended for sale in the United States but are not suitable for other countries. This would impose unreasonable costs on the U.S. marketplace.

The Commission should define the term "readily altered" to mean "readily altered by a person with non-expert electronics skills."

INTEREST OF JEFFREY KRAUSS

I am a telecommunications policy professional. I have been employed since 1970 by Bell Telephone Laboratories, American Satellite Corporation, the Federal Communications Commission, and M/A-COM, Inc. For each of these employers, I was responsible for analyzing and preparing recommendations in matters of telecommunications technology and policy and radio spectrum management. I am currently an independent consultant in radio spectrum management and telecommunications policy.

During the 1987-92 time period, I have prepared comments and studies for my clients that were filed in the following FCC dockets and investigations:

Docket No. 85-301, Cable TV Terminal Devices
Docket No. 86-336, Scrambling of Satellite TV Signals
Docket No. 86-495, Allocation of Spectrum for Basic Exchange Telecommunications Radio Service
Docket No. 86-496, Implementation of Reduced Orbital Spacing for Satellites
Docket No. 87-5, 900 MHz Multiple Address Frequencies
Docket No. 87-24, Cable TV/Broadcast Program Exclusivity
Docket No. 87-136, Reallocation of Spectrum for Local Television Transmission Service
Docket No. 87-215, Access Charges for Enhanced Service Networks
Docket No. 87-268, Advanced Television Systems
Docket No. 87-389, Revision of Part 15 (Low Power Communications Devices)
Docket No. 87-530, Access Charges for Private Line Networks
Docket No. 87-552, Equipment Authorization Procedures
Docket No. 88-2, Open Network Architecture
Docket No. 88-57, Connection of Inside Wiring to the Telephone Network
Docket No. 88-96, Spectrum for Air-to-Ground Telephone Service
Docket No. 89-78, Satellite Encryption Standards
Docket No. 89-89, Satellite Syndicated Exclusivity
RM-5879, Petition for 6425-6875 MHz Spectrum Allocation
RM-6014, Petition for 18 GHz Video Distribution
RM-6196, Petition for 220 MHz Allocation for Two-Way TV Return Channel
Docket No. 89-554, Preparation for 1992 WARC
Docket No. 90-5, Distribution of Video Entertainment at 18 GHz
Docket No. 90-217, Pioneer Preference for Spectrum
Docket No. 90-314, New Personal Communications Services
RM-7628, C-Band Satellite Orbital Spacing
Docket No. 91-1, Television Decoder Circuitry
Docket No. 91-169, Cable Television Technical and Operational Requirements
Docket No. 92-9, Spectrum for Emerging Telecommunications Technologies
Docket No. 92-115, Revision of Part 22
Docket No. 92-160, IFRB Registration

During 1987-1992, I have worked on the following projects and studies for selected clients:

- use of 28 GHz for point-to-multipoint distribution of video;
- impact on equipment manufacturers if Bell Operating Companies are permitted to diversify into manufacturing and enhanced services;
- use of microwave to bypass telephone services in Manhattan;
- negotiations with FCC and Commerce Department staff on transmission power levels applicable to microwave intrusion alarms and motion sensors;
- technical means for implementing "syndicated exclusivity" in cable TV systems;
- regulatory feasibility of implementing new communications and radiolocation technologies in unused or little-used radio spectrum allocations;
- testimony used in five Congressional hearings;
- negotiations of legislative language affecting Digital Audio Tape consumer equipment;
- negotiations with the U.S. Copyright Office regarding the permissibility under the copyright laws of cable converter on-screen displays and menus;
- participation as an expert witness in lawsuits involving digital satellite earth stations, digital microwave systems and home satellite dishes;
- analyzing the interference from Navy radars into paging services around 930 MHz;
- reallocation of Federal Government spectrum for non-Government services.

Both prior to and throughout my professional career, I have also been a radio communications hobbyist. I have built and/or owned radio receivers, converters and scanners. I have also used radio receivers and scanners as part of my professional responsibilities.

I am submitting these comments because I fear that the Commission, by adopting overly stringent language to implement Public Law 102-556, might adversely affect the price and availability of radio scanners. I believe that such a result would be contrary to the intent of Congress and contrary to the public interest.

WIDELY AVAILABLE INEXPENSIVE SCANNERS SERVE THE PUBLIC INTEREST

The widespread availability of reasonably priced radio scanners serves the public interest.[2] Scanners have the legitimate purpose of receiving a variety of fixed and mobile communications. The Electronic Communications Privacy Act of 1986 confirmed that scanners may be used to receive public safety communications, including police and fire department messages, and other Part 90 communications systems.

Scanners are used by public safety agencies and officers to keep track of events within their own jurisdictions and in adjacent jurisdictions. For example, in Montgomery County, Maryland, the County Police normally operate on five radio channels, one for each of the five police districts. Police officers use scanners, which they own personally, to keep themselves informed of events in other districts. Similarly, both police officers and fire department officials use scanners to keep informed of each other's activities at accident and shooting scenes where both agencies are working but joint command posts are not yet established.

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[2]There is no record to dispute this claim. Section 403 of the Telephone Disclosure and Dispute Resolution Act (Public Law 102-556) was enacted without hearings on the scanner provisions. The language originated as Section 9 of H.R. 1674, which passed the House without a hearing. Although the general topic of interception of communications is within the jurisdiction of the Judiciary Committees, this legislation was never referred to the Judiciary Committees. On the other hand, the Senate Judiciary Committee, as recently as 1991, reviewed the issue of protection for cellular communications and found that no additional protection was needed. See Final Report of the Privacy and Technology Task Force, Senate Judiciary Committee, May 28, 1991.

Similarly, at jurisdictional boundaries, scanners provide a valuable source of information to public safety officials. While police agencies and fire departments have mutual aid radio frequencies to allow communications across jurisdictional boundaries, these mutual aid frequencies are secondary rather than primary and do not carry most of the important radio communications traffic. Moreover, in the same way that there are no frequencies for communications between police and fire departments within jurisdictions, there are also no frequencies for inter-jurisdiction joint communications among police and fire departments.

Scanners are also widely used by the news media to monitor and report on breaking news events. For example, the right of news agencies to listen to and report on Government agency communications is an important First Amendment right.

Scanners also play an important role in contributing to transportation efficiencies. In the Washington, DC area and other large urban areas, organizations such as Metro Traffic Control provide scanner-derived traffic congestion information to the public. By listening to Metro Traffic Control reports on local broadcast stations, individual drivers can adjust their routes of travel to avoid congestion. This provides a substantial economic benefit to society, by reducing travel time and energy costs. While some of Metro Traffic Control's information is derived from direct sightings by its airborne reporters, other information comes from scanners tuned to local police, fire department and highway maintenance frequencies.

In addition to these professional uses of scanners, scanners are also in demand and in widespread use by the general public. While scanners are sold by specialized electronics shops such as Radio Shack, they are also sold by general merchandise retailers such as Best & Co. and Service Merchandise. Whatever it is that makes TV shows such as "911" and "Cops" popular also makes scanners popular among the general public.[3]

In adopting the proposed restrictions on scanner design, any Commission action must weigh the possible adverse effect on these professional and general consumer applications.

ANALOG CELLULAR CALLS WILL NEVER BE SAFE FROM INTERCEPTION

The benefits of the proposed rules are likely to be small in today's analog cellular environment. With or without the proposed rules, analog cellular calls will never be safe from interception.

In spite of Public Law 102-556 and Commission actions in this proceeding, cellular communications will not be truly protected against interception until the cellular industry moves

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[3]The Commission's Initial Regulatory Flexibility Analysis (Notice, para. 13) is incorrect in claiming that the proposed rules would affect fewer than 50 small entities. While there may be fewer than 50 scanner manufacturers, the proposed rules could adversely affect thousands of small businesses and tens of thousands of members of the public who are potential scanner purchasers and users. The proposed rules could raise the price of scanners and could cause certain scanner models to be withdrawn from the market without replacement models being developed.

from analog to digital technology. The current FM voice cellular transmissions can be received on TV sets that can be tuned to former TV channels 70-83, and possibly by cable TV converters.[4] Moreover, there are scanner models now on the market, and thousands of scanner receivers that were sold and may be resold,[5] capable of receiving cellular calls without modification.[6]

Therefore, although the proposed rules may limit the future production of scanners that can receive cellular frequencies, cellular telephone subscribers should not have any false sense of confidence that their analog coded conversations are safe from interception. Even with the proposed rules in place, it would be wrong for the cellular industry to market its product as safe from interception so long as the service uses analog technology.

Digital voice coding will change the security of cellular calling dramatically. Digital decoders will not be available in scanners. The digital voice coding algorithm that was adopted by the cellular telephone industry is proprietary. Unlike analog FM or digital PCM coding,

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[4]Notice, footnote 8.

[5]Neither the law nor the proposed rules would have any effect on scanners manufactured or imported prior to April 26, 1994.

[6]In addition, many of the scanners now sold with the cellular frequencies "locked out" can actually receive cellular transmissions by tuning to a frequency about 21 MHz (twice the intermediate frequency) above or below cellular frequencies. The "IF image" of the cellular transmission is actually being detected. Two of the scanners I now own can receive cellular transmissions this way. The proposed rules do not appear to regulate the IF image rejection or the quality of filtering in scanners.

it is not in the public domain. Its use is controlled by the patent laws of the United States.[7]

Even when digital cellular technology is widely implemented, however, it is unlikely that cellular conversations will be fully safe from interception. Anyone truly intent on cellular eavesdropping will almost certainly be able to illegally modify a cellular transceiver to act as a scanner.[8] Cellular transceivers today are notoriously capable of being modified for fraudulent purposes. As the home dish industry learned, it is impossible to control the modifications that will be attempted on widely available consumer electronics products, if the economic incentives are great enough.[9] Unlike the home dish industry, the cellular industry has devoted little or no effort to developing encryption techniques for protecting against unauthorized interception.

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[7]Therefore, the last sentence of proposed Section 15.121, which prohibits scanners from converting digital cellular transmissions to analog voice audio, is unnecessary. Use of digital voice decoding technology by the cellular industry will be controlled under the patent laws. Other mobile communications users will migrate to digital voice coding as well, but they are likely to use different voice coding algorithms. For example, the police communications industry association has adopted a proprietary digital voice coding technology, known as Improved Multi-Band Excitation (IMBE), rather than the cellular method known as Vector Sum Excited Linear Prediction (VSELP). See Land Mobile Radio News, September 4, 1992 at p. 1. The Commission should confirm that it has no intention to limit the use of IMBE or other digital voice decoders in scanners.

[8]I understand that some cellular transceivers today can be put into "test mode" whereby they act as scanner receivers and can monitor all cellular frequencies.

[9]See generally Notice of Inquiry in PP Docket No. 92-234, 7 FCC Rcd 7276, and sources cited therein. Home dish piracy has been achieved by illegal modifications of legally manufactured home dish receivers, not by illegal manufacture of pirate receivers.

The cellular industry today could take a significant step toward discouraging scanner listening to cellular calls by eliminating the rebroadcast of mobile station transmissions on base station frequencies. Today it is convenient to listen to cellular conversations on a scanner because the base station frequency carries both sides of the conversation. Only one scanner is needed to listen to the complete conversation. But there is no apparent need for the base station to rebroadcast the mobile transmissions.[10] The cellular industry could immediately and effectively discourage scanner listening by eliminating the base station rebroadcasts. This could be done by employing technology similar to satellite echo cancellers. If that were done, two scanners would be needed to a cellular conversation, one tuned to the base station frequencies and one tuned to the mobile frequencies. This would be impractical unless the economic incentives were great.

THE COMMISSION SHOULD NOT IMPOSE SUBSTANTIAL COSTS ON SCANNERS

It would be wrong for the Commission to adopt regulations that substantially increased the costs of scanners. But that risk exists if scanners sold in the U.S. must be designed differently than those sold in other countries. As the Commission correctly notes, many scanners are marketed worldwide.[11] But frequency usage is not entirely consistent throughout the

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[10]This is different from dispatch communications such as police communications, where it is often vital for all units in the field to hear both sides of a conversation.

[11]Notice, para. 7.

world. Consequently, scanner manufacturers have developed models that have the same underlying architecture and structure but have slight variations from one country to another.

The case of Australia is a typical example. The VHF and UHF frequencies used for fixed and mobile communications in Australia are almost the same as in this country. The exception is that for low-band VHF, 30-50 MHz is used in this country while 66-88 MHz is used in Australia. Consequently, essentially the same scanner models are sold in the two countries. The current Australian catalog of Tandy Electronics, Australian affilate of Radio Shack, illustrates this.[12] Attachment 1 shows copies of pages from this catalog. The U.S. and Australian PRO-39, PRO-35 and PRO-36 are identical except for the low-band VHF. The PRO-2006 and PRO-2022 are the same except for low-VHF in the PRO-2022 and the cellular band lockout in the U.S. models.

The benefit of such a design is that most of the components can be produced in volumes large enough to generate substantial economies-of-scale cost reductions. Using the same microprocessor,[13] but with slightly different firmware or circuitry enabled, essentially the

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[12] 1992-93 Tandy Electronics Technology Catalogue, published by InterTAN Australia Limited, 91 Kurrajong Avenue, Mt. Druitt, New South Wales, Australia, at pages 86-87.

[13] The suggestion, in footnote 7 of the Notice, that scanner manufacturers be required to design new microprocessors correctly notes that this would result in cost increases. The costs would come both from one-time engineering and design costs, and from the lower production volumes inherent in specialized designs. However, the ability to tune certain frequencies and not others is almost certainly contained in the firmware and control circuitry of the receiver, not the microprocessor.

same product can be customized for the particular frequencies in use in each country. But requiring substantially different designs or different components is likely to reduce the manufacturing volume of each component and thereby raise the total cost of the product.[14]

"READILY ALTERED" SHOULD ASCRIBE NON-EXPERT ELECTRONICS SKILLS

The Commission seeks to define the term "readily altered" which was used in the law.[15] But there is no legislative history to guide the Commission, since no hearings were held on the provision. Consequently, in reaching a decision, the Commission must rely on its own analysis to balance the possible public interest benefits of increased cellular calling security[16] against the cost to society of more expensive consumer electronics products.

The Commission should define "readily altered" to mean "readily altered by a person with non-expert electronics skills." This will provide a reasonable balance between costs and benefits. It will discourage the large percentage of cellular owners from trying to modify their product, and thereby provide some protection against interception. And it will allow

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[14]The suggestion, in footnote 7 of the Notice, that semiconductors should not be permitted to be mounted in sockets in scanners is unlikely to have any practical effect, since most new products likely to be affected by these rules will probably employ less expensive wave solder or surface mount technology.

[15]Notice, para. 8.

[16]These benefits are not likely to be large in today's analog environment, as discussed previously.

manufacturers to design their products so that they can continue to build basically the same unit for many different countries.

Several scanners now on the market can be readily altered by non-experts. But other models can be altered only with by those with much greater expertise.

The Radio Shack PRO-2004, 2005 and 2006 can be readily altered without any electronics expertise. For example, the modification to the PRO-2004 is done as follows:

- Remove the four rear apron screws and withdraw the radio from its cabinet; turn the radio over.
- Locate the shielded compartment on PC-3 and pry off the cover.
- Locate diode D513 and cut either lead of the diode.
- Reassemble the scanner.

The PRO-2005 and 2006 modifications are similar.

The Radio Shack PRO-2022 cellular modification is described in a publication that is sold by electronics hobby shops and mail order.[17] The modification is even simpler than the PRO-2004 modification; diode D-44 must be cut, and it is immediately accessible, rather than hidden within a shielded compartment.

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[17]Scanner Modification Handbook, Volume 2, published by CRB Research Books, Inc., PO Box 56, Commack NY, at p. 196.

Clearly these modifications can be accomplished by non-experts.

In contrast, the modification to the Uniden BC-760XLT and BC-950XLT is far more complex and requires a much higher degree of expertise.[18] The modification is done as follows:

- Remove four screws and the covers.
- Locate the UC-1246 chip.
- Cut the two traces leading to pin 26 of the UC-1246 chip. One is on the top on the board and one is on the bottom.
- Solder one end of a 10K resistor to pin 26 of the UC-1246 chip. Solder the other end to pin 32 of the UC-1246 chip.
- Solder one end of a wire across pins 19 and 20 of the UC-1246 chip to short them together. Solder the other end of the wire to the circuit board trace that was cut away from pin 26.

The instructions contain several reminders to watch out for shorts and solder blobs. Clearly this procedure requires a level of expertise that goes far beyond the non-expert level. Relatively few scanner owners will be willing to attempt this procedure.

I have reprinted below the instructions for restoring cellular frequencies to the Radio Shack PRO-43 scanner. Once again, a high level of electronics expertise is needed.

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[18]Scanner Modification Handbook, Volume 2 at p. 212.

- Remove the battery pack and cover.
- Remove the four screws on back and GENTLY pry apart.
- Remove the 6 silver screws from the 1st PC Board.
- Remove solder from the ground pad and center feed conductor of the antenna directly under the antenna on the PC Board. Heat solder on top PC Board and center feed will loosen; this is the really tricky part.
- Disconnect the 2 plugs and wiring harnesses. Make note of the color scheme for re-installing. Harness has 2-metal guides on the side. BE CAREFUL NOT TO PINCH WIRES.
- Lift top board away from bottom, and paying careful attention the black plug near the bottom of the assembly, gently pry this apart. DO NOT FORCE IT!
- Remove 2 silver screws from the 2nd PC Board. Remember to replace on re-assembly.
- Remove solder from the four points on the large silver shield covering the micro-processor board. Remove shield. Make sure to replace shield on re-assembly as this serves as protection from intermod and interference.
- Near the bottom you will see a row of surface mount diodes (very small and square, approx 1/32 inch long, black with gray markings) These will be in locations marked D1, D2, D3, D4, D5. Some of the locations are blank.
- Using a very low temp iron (15-watt) and the smallest solder wick available, remove the solder from both sides of D4. Use hemostats or needle nose (very

small) to grip while desoldering. Remove diode D4. Another method you could use would be to (use magnifying glass) crush and remove D4 with the needle nose pliers. Make sure all of the pieces are removed and nothing is touching or connecting.

- Once D4 is removed you will have full 800 MHz coverage and 30 KHz spacing on cellular.
- Carefully re-assemble unit, remembering to double check each step before going on to next step.

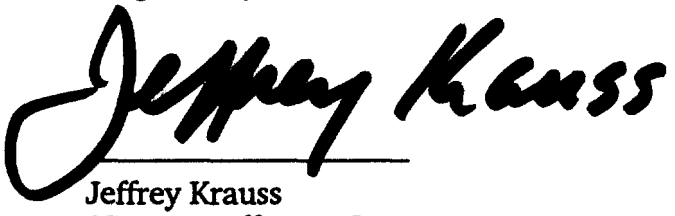
Consequently, it can be seen that there are some scanner models now on the market that are readily modified by non-experts, but others that require far greater electronics skills. The Commission should adopt rules that would prohibit the sale of the former, but should not prohibit the availability of the latter. This would strike a reasonable balance among the competing interests.

CONCLUSIONS

In light of the above considerations, the Commission should carefully weigh the potential benefits to cellular security against the potential costs to scanner users in adopting the pro-

posed rules. To the extent possible, the rules should be written and interpreted so as to minimize the cost impact on scanner users, since the benefits to cellular callers are likely to be small.

Respectfully submitted,



Jeffrey Krauss
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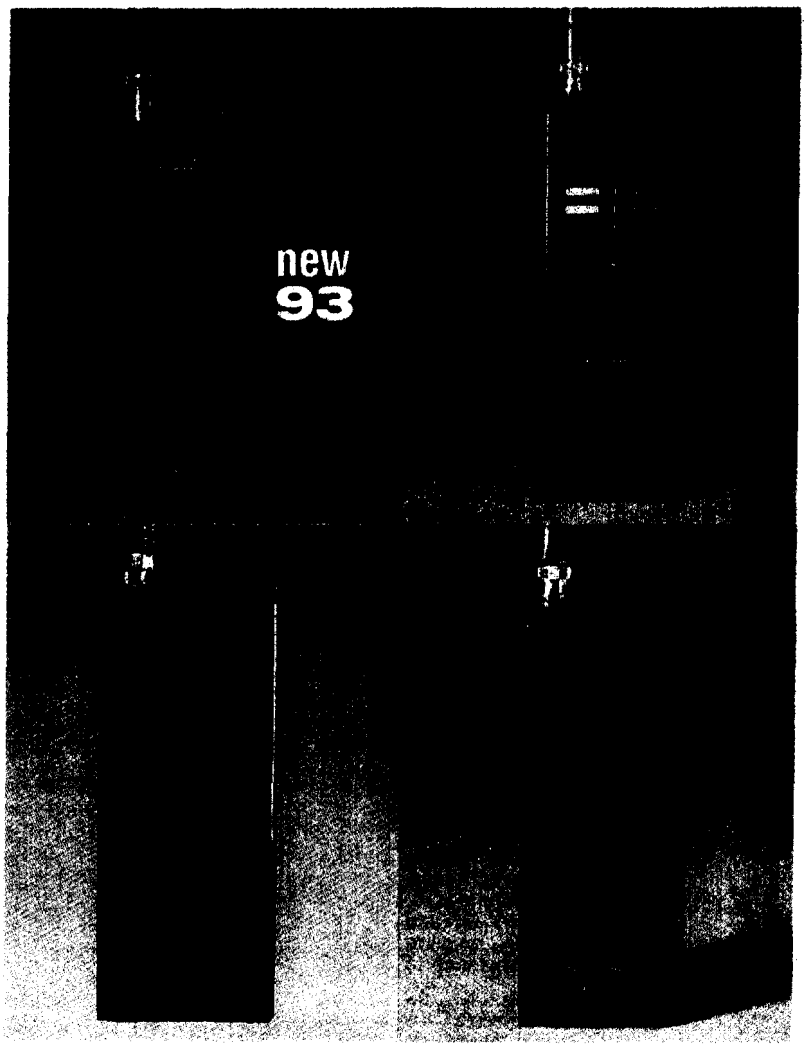
Rockville, MD 20850
301-309-3703

Date: February 22, 1993

Attachment 1

Portable Programmable Scanners



200-Channels Plus Hyperscan

1. **Realistic® PRO-39 200-Channel Scanner.** Action-packed! Scans up to 200-channels in 10-banks, and with its hyperscan feature it can scan 25-channels per second! Frequencies found during search can be stored in a special monitor bank, there's a lock-out key, two-speed scan, limit/direct search, 10-digit channel/frequency display, switchable backlight and jacks for a BNC antenna, earphone and charge. Frequency coverage: 68-88 MHz, 118-136.975MHz, 137-174 MHz, 380-512 MHz, 806-823.9375 MHz, 851-868.9375 MHz and 896.1126-960 MHz. 16.5x6.8x 4.1cm. Requires 6 AA batteries, AC or DC adapter.
20-9303 ..... **499.95**

100-Channels and Auto-Scan

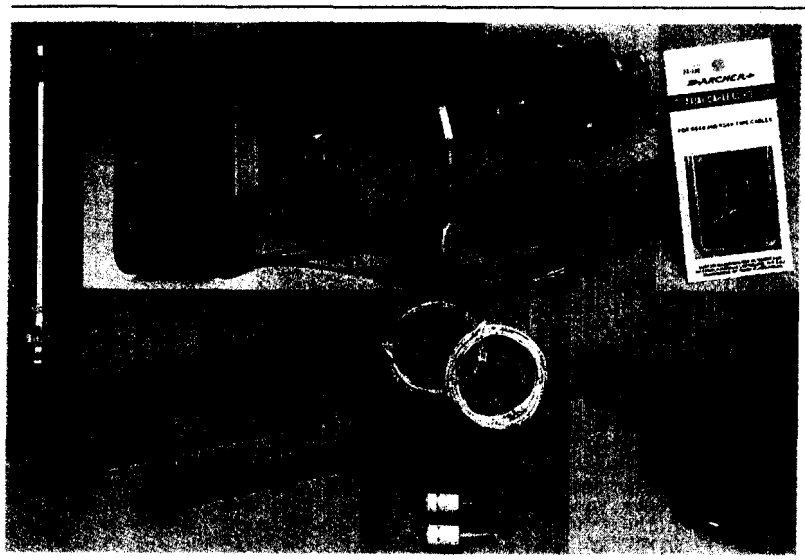
2. **Realistic PRO-35 100-Channel Scanner.** A quality 100-channel, direct entry programmable scanner with direct access to over 22,000-frequencies — that means no crystals to buy! It comes with automatic scan of 100-memory channels, a lighted LCD screen, two-second scan delay and lock-out function. Frequency range: 66-88 MHz, 108-136.975 MHz, 137-144 MHz, 144-148 MHz, 148-174 MHz, 406-450MHz, 450-470 MHz and 470-512 MHz. It includes rechargeable battery. 18.9x6.9x3.5cm.
20-9136 ..... **369.95**

20-Channels and Search Mode

3. **Realistic PRO-36 20-Channel Scanner.** Extra rugged and loaded with features! Has a low-battery indicator, memory backup for channel entries, up and down direct search, and an optional 2-second scan delay. Frequency coverage: 68-88 MHz, 108-136 MHz, 136.005-144 MHz, 144-148 MHz, 148-174 MHz, 380-450 MHz, 450-470 MHz and 470-512 MHz. Includes flexible antenna, built-in speaker, belt clip and BNC antenna jack. 16.5x6.9x4.6cm. Requires 6 AA batteries or AC or DC adapter.
20-9137 ..... **349.95**

10-Channels and Auto-Delay

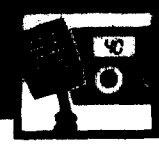
4. **Realistic PRO-41 10-Channel Scanner.** Access frequencies including fire, amateur radio and transport services. Allows you to store frequencies in the 10-channels, as well as change them at any time. Has a channel/frequency LCD, automatic 3-second scan delay and memory backup. Frequency coverage: 66-88 MHz, 137-174 MHz and 406-512 MHz. Comes with external sockets for earphone, power and charge. 17.8x6.7x3.5cm. Requires 5 AA batteries or AC or DC adapter.
20-9301 ..... **249.95**



All the Proper Accessories

5. **Centre-Loaded Telescopic Antenna.** Receives from 25-1296 MHz. Transmits from 130-535 MHz. BNC connector.
20-006 ..... **19.95**
6. **Scanner Case.** Give your portable scanner extra protection when being transported or stored, with this durable black vinyl case. Has belt loop. **20-004** **21.95**
7. **Headset.** With ¼" and ⅛" plugs.
20-210 ..... **19.95**
8. **Antenna Surge Absorber.**
20-021 ..... **29.95**
9. **AM/FM Radio and Scanner Coupler.**
20-9710 ..... **39.95**
10. **Coax Clips.** Place over cable and nail to wall. Keeps secure.
RG58/U. **20-192** **10/1.99**
Coax Clips for RG8/U. **20-193** **6/1.99**
11. **Mounting Brackets.** Simple to install and suits #20-9145 and #20-9127 scanners. **20-9601** **49.95**
12. **The Complete Shortwave Kit.** Everything you need for an outdoor antenna is included! **278-758** **24.95**
13. **Shortwave Antenna. 278-1374** **14.95**

Get the News As It Happens!



400-Channels Plus Hyperscan!

699.95

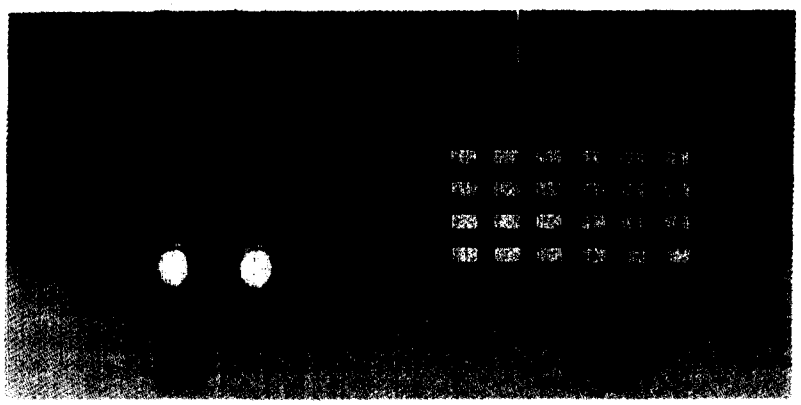
- **Hyperscan Doubles Scanning Speed — 13 or 26-Channels Per Second**

Realistic® PRO-2006. Desk-top programmable scanner puts you in the action! Enjoy expanded listening with access to over 207,000 frequencies in nine radio bands including aircraft and ham radio, as well as normal FM broadcasts, TV sound and CB. Features 40-channel memory banks, a 10-channel monitor bank for temporary storage, plus search and favourite-channel priority functions. Sound and squelch control prevents lockups on unmodulated carriers. Has a custom-designed microprocessor which saves you changing crystals when selecting frequencies, and a backlit liquid crystal display with dimmer. Jacks: tape out, ⅛" headphone, external speaker, external DC power, BNC antenna input. Memory backup requires 9V battery. Frequency range: 25-520 MHz, 760-1,300 MHz. 240V AC (or 12V DC adapter extra). 7.6x22x20.5cm. **20-9145** **699.95**

200-Channels Plus Search

499.95

- **Has Aircraft Band and Priority Function**
- **Over 32,000-Frequencies**



Realistic PRO-2022. Memory stores channels in 10-banks of 20-channels each for personalised monitoring. Channels found during two-speed search can be temporarily stored in a 10-channel monitor bank, then transferred to memory with the touch of one key. Has selectable priority channel, individual channel lockout, two-second scan-delay so you don't miss important channels, and a multi-function liquid crystal display that makes reading easy. Frequency coverage 68-88, 108-136, 138-174, 380-512, 806-960 MHz. Has jacks for ⅛" headphone, external speaker, external DC power, BNC antenna input. 7.6x22.2x20.6cm. 240V AC (or 12V DC power cord, extra). Memory backup requires 9V battery.
20-9127 ..... **499.95**

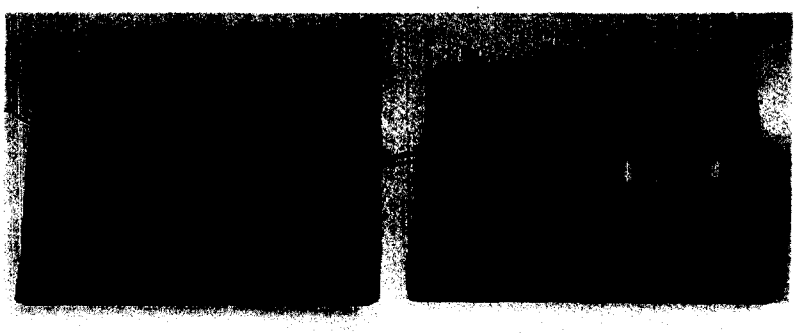
60-Channels and Monitor Bank

299.95

- **Search and Priority Functions**
- **Channel Lockout Key**
- **Over 22,000-Frequencies**

Realistic PRO-2024. Be on-the-scene instantly — hear emergency calls, aviation and marine communications, ham radio, rail and more from your own living room. Features two-speed scan and search modes, a monitor bank which temporarily stores up to six channels found during search, and favourite-channel priority so you never miss a call on your most listened-to channel. You can skip over unwanted channels with the electronic channel lockout key and the easy-to-read LCD shows channel, frequency, status (lockout or scan-delay) and mode of operation — makes programming a snap! Frequency coverage: 68-88, 118-136, 138-174, 380-512, MHz. Memory backup. Jacks for ⅛"headphone, external speaker and antenna. 6x25x18cm. 240V AC. **20-9129** **299.95**

16 and 10-Channel Scanners



1. **Realistic PRO-2023 16-Channel Scanner.** Enjoy direct access to over 22,000-frequencies including amateur radio and transportation services. LCD shows channel and frequency. Also has scan delay, memory backup & lock-out function. Frequency range: 68-88, 118-136, 136-144, 144-148, 148-174, 406-450,450-470,470-512 MHz. 6.2x24x18cm. 240V AC.
   20-9128 ..... **249.95**
2. **Realistic PRO-58.** A breakthrough for listeners on a budget! Has keyboard access to over 21,000-frequencies and you can select any of the 10-channels manually or by scanning. Also has lock-out key to bypass unwanted channels and memory backup. Frequency coverage: 68-88 MHz, 138-174 MHz and 380-512 MHz. 12V DC adapter included. 20x17.5x5.2cm.
   20-9400 ..... **199.95**

Tandy Extended Warranty Plans are Available for our Entire Range of Scanners, Ask Your Store Manager for Details